FGDC Document Number

NSDI

National Spatial Data Infrastructure

United States National Grid
(Public Review Draft)

Standards Working Group
Federal Geographic Data Committee

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Federal Geographic Data Committee
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Department of Housing and Urban Development, Department of the Interior, Department of State
Department of Transportation, Environmental Protection Agency
Federal Emergency Management Agency, Library of Congress
National Aeronautics and Space Administration, National Archives and Records Administration
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Federal Geographic Data Committee

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1. INTRODUCTION

1.1 Objective

The objective of this standard is to create a more favorable environment for developing location-based services within the United States and to increase the interoperability of location services appliances with traditional printed map products by establishing a nationally consistent grid reference system as the preferred grid for National Spatial Data Infrastructure (NSDI) applications.

There are a number of coordinate reference systems that can be used either in location service appliances or on printed maps for the purpose of establishing a location. Within automated location service appliances, the conversion of coordinates based on one well-defined reference system to coordinates based on another can be both automatic and transparent to the user. These devices can support multiple coordinate reference systems with little difficulty. However, it is not easy for humans to work in multiple reference systems and humans cannot convert between systems without the aid of location service appliances, calculators, or conversion tables. Furthermore, it is difficult for humans to accurately determine a location coordinate from paper maps when spherical coordinate reference systems, like latitude and longitude, are used because they do not appear square on the flat map. As a consequence paper maps created for the general public frequently have a square reference grid that overlays the non-rectangular coordinate reference system. It is computationally difficult, labor intensive, and time consuming to convert the reference grid coordinate obtained from one printed map to another printed map with a different grid even when both grid reference systems are well defined. It can be impossible when proprietary grids are used. This situation greatly limits the ability of humans to use location service devices with traditional printed maps. Subsequently, location based services in this country have been limited to totally digital environments, restricting the number of users and uses and retarding the development of the location based service industry.

This standard seeks to improve the current situation by identifying a single nationally consistent, humanly facile grid reference system as the preferred U.S. National Grid (USNG) and promoting its use within the NSDI.

1.2 Scope

This standard defines a preferred U.S. National Grid (USNG) for large and medium-scale[1] mapping applications. It defines how to present UTM coordinates at various levels of precision. It specifies the use of those coordinates with the grid system defined by the Military Grid Reference System (MGRS). Additionally, it addresses specific presentation issues such as grid spacing. The UTM coordinate representation, the MGRS grid, and the specific grid presentation requirements together define the USNG. This standard is a process standard as defined by the FGDC Standards Reference Model. Specifically, it is a presentation process standard.

1.3 Applicability

This standard is for use in the acquisition or production, either directly or indirectly through contracts and partnerships, of printed maps and the acquisition, either directly or indirectly, of location service appliances. The USNG addresses the geospatial coordinate, human interface of products and services designed as interoperable components of the NSDI. This standard applies to printed maps that are intended to be used or are likely to be used by humans in conjunction with location service appliances and to location service appliances that are intended to be used or are likely to be used by humans in conjunction with printed map products.

This standard is not applicable to the collection of geospatial data, either remote sensed data collection or field surveys. This standard is not applicable to the internal data storage structure of

[1] For this standard, large and medium-scale shall be defined as from approximately 1:5000 to 1:1,000,000 applications.

any GIS or location service appliance or to the transfer of coordinates between databases or appliances.

Use of USNG grid coordinates may be useful or even desirable within some systems or enterprises. The decision to use USNG grid coordinates or some other coordinate system internal to geographic information systems or location service appliances is left to the discretion of the system developer as long as the human interface provides for USNG grid coordinate readout as one option.

The USNG is not applicable to surveying. This standard does not attempt to replace the State Plane Coordinate Systems (SPCS) established by the National Geodetic Survey specifically for field surveying. The SPCS is specifically designed to meet the requirements of surveyors and engineers in determining location and boundaries and most states mandate its use by law especially for cadastral surveys. The USNG does not address those needs. SPCS coordinates can be readily converted to USNG grid coordinates for subsequent use within the NSDI.

The USNG is interoperable with the MGRS. This will be of critical importance to safety of life during times of disaster relief operations.

1.4 Related Standards

This standard is compatible with:

- ANSI X3.61-1986, Representation of Geographic Point Locations for Information Interchange, which standardizes representation of UTM coordinates for computer representation.

- ISO/DIS 19116, Positioning Services, which provides an interface for real-time output from a GPS receiver and other positioning technologies.

- ISO/DIS 19111, Spatial Referencing by Geographic Coordinates, which provides a conceptual schema for the description of coordinate reference systems.

- The USNG standard is based on the MGRS.

1.5 Standards Development Process

The USNG is an initiative of the Public XY Mapping Project, which is a not-for-profit organization created specifically to promote the concept of a national grid for the United States. The original concept can be traced to discussions within the American Society for Photogrammetry and Remote Sensing. The Public XY Mapping Project developed the idea conducting tests and surveys to determine which coordinate reference system best met the nationally consistent and ease of human use requirements. Based on this research and testing, a standard based on the Military Grid Reference System (MGRS) was developed.

Because of the importance of this project to the NSDI, the Public XY Project brought its findings to the Federal Geographic Data Committee (FGDC) in 1998. After briefing the FGDC Coordination Group, an ad hoc study group, that included the FGDC Staff Director and the Chair of the FGDC Standards Working Group, recommended that the FGDC accept the project as an FGDC standard development activity. The FGDC Standards Working Group then created a subgroup led by the Public XY Mapping Project to husband the project through the FGDC standards process. The subgroup contains members from both the public and private sector, including key participation from the National Imagery and Mapping Agency to assure that the USNG retains interoperability with the MGRS. The subgroup refined the standard and through an iterative review process with the FGDC Standards Working Group, produced, in November 2000, a final draft for public review consistent with the FGDC standards directives.

1.6 Maintenance Authority

The Public XY Mapping Project will maintain this standard for the first five years. The Public XY Mapping Project has demonstrated the ability to marshal the resources needed to develop, promote, and initially implement the standard. After five years, the FGDC Standards Working Group will evaluate the need to move maintenance responsibility to one of the A-16 agencies.

2. CONFORMANCE

Location service appliances that claim conformance to this standard shall accept USNG coordinates, as defined in Section 3, as input from the human user and provide USNG coordinate output to the human user, as at least one option.

Printed map products that claim conformance to this standard shall provide a means for humans to accurately locate a USNG coordinate on the map and for humans to extract, for any point on the map, an accurate USNG coordinate. This will usually mean that the USNG will be printed on the map according to the guidance in this specification.

3. MAIN FEATUES AND SPECIFICATIONS.

3.1 Equivalency With MGRS

USNG coordinates shall be identical to the MGRS numbering scheme over all areas of the United States including outlying territories and possessions.

3.2 Basic Numbering

USNG basic coordinate values and numbering are identical to UTM coordinate values over all areas of the United States including outlying territories and possessions.

3.3 Referencing Scheme

Numbering scheme shall be alphanumeric as follows:

3.3.1 Grid Zone Designation

First, the U.S. geographic area shall be divided into 6-degree longitudinal zones designated by a number and 8-degree latitudinal bands designated by a letter. Thus each area is given a unique alpha-numeric Grid Zone Designator (GZD) (Annex A, Figure 1).

The longitude zone numbers and latitude band letters for GZD over the United States shall be taken from the global scheme of MGRS.

18S – Identifies a GZD.

3.3.2 100,000-meter Square Identification

Each GZD 6x8 degree area shall be covered by a specific scheme of 100,000-meter squares where each square is identified by two unique letters (Annex A, Figures 2 and 3). The 100,000-meter Square Identifications shall be taken from the scheme defined by the MGRS.

18SUJ – Identifies a specific 100,000-meter square in the specified GZD.

3.3.3 Grid Coordinates

A point position within the 100,000-meter square shall be given by the UTM grid coordinates in terms of its Easting (E) and Northing (N). An equal number of digits shall be used for E and N where the number of digits depends on the precision desired in position referencing. In this convention, the reading shall be from left with Easting first and then Northing.

Examples:

18SUJ20	- Locates a point with a precision of 10 km
18SUJ2306	- Locates a point with a precision of 1 km
18SUJ234064	- Locates a point with a precision of 100 meters
18SUJ23480647	- Locates a point with a precision of 10 meters
18SUJ2348306479	- Locates a point with a precision of 1 meter

The number of digits in Easting and Northing can be varied, depending on specific requirements or application.

4. RELATIONSHIP TO DATUMS

The standard datum for USNG coordinates shall be the North American Datum 1983 (NAD 83) or its international equivalents, the World Geodetic System 1984 (WGS 84), and the International Terrestrial Reference Frame (ITRF).

For practical applications using an existing map referenced to North American Datum 1927 (NAD 27), see Annex B.

5. ACCURACY AND PRECISION

5.1 Accuracy

Paper maps using the USNG grid shall conform to the National Map Accuracy Standard.

5.2 Precision

USNG provides a flexible numbering scheme to accommodate variable precision from tens of kilometers to one meter or higher.

5.2.1 Field Applications

For general field applications, it will be typical to use to a precision of one hundred or ten meters.

5.2.2 Special Applications

For special applications, the USNG provides precision up to one meter or higher.

For example, the location of the Washington Monument in Washington, DC can be identified in NAD 83 datum.

General reference:	18SUJ23480647
Special application:	18SUJ2348316806479498

6. REFERENCES

American National Standards Institute, Inc. (ANSI), 1986, American National Standard for Information Systems - X3.61-1986, Representation of Geographic Point Locations for Information Interchange (Formerly Federal Information Processing Standard 70-1)

National Imagery and Mapping Agency (NIMA), 1990, DMA Technical Manual 8358.1 Datums, Ellipsoids, Grids, and Grid Reference Systems, Edition 1

Synder, John P., 1987, Map Projections - A Working Manual; U.S. Geological Survey Professional Paper 1395, US Government Printing Office, Washington, DC

Thompson, M.M., 1979, Maps for America, US Government Printing Office, Washington, DC

United States National Grid

Annex A (Normative)

Normative Figures

United States National Grid

Annex B (Normative)

Use of North American Datum 1927 (NAD27)

ANNEX B (Normative)

Use of North American Datum 1927 (NAD 27)

B.1 Map Producers

Map producers who must use the obsolete North American Datum 1927 (NAD 27) shall prominently place a note on the product that the 100,000-meter square identifications are different from those employed in WGS 84/NAD 83/ITRF. Producers shall refer to National Imagery and Mapping Agency (NIMA), 1990, Defense Mapping Agency (DMA) Technical Manual 8358.1 Datums, Ellipsoids, Grids, and Grid Reference Systems, Edition 1, Appendix B, Figure B-4 for the labeling scheme used with NAD 27.

B.2. Users

When expressing a spatial coordinate referenced to NAD 27, users shall include a reference to NAD 27 with the coordinate.

Example: 18SUT06909680 (NAD 27)

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Annex C (Normative)

Truncation of USNG Coordinate Values

ANNEX C (Normative)

Truncation of USNG Coordinate Values

A uniform system of truncation is adopted for the USNG[2]. Truncated coordinates begin with the 10,000-meter digit. Truncated coordinate values shall always consist of an even number of digits. Table 1 demonstrates how to truncate USNG grid coordinate values and compares these with truncated UTM grid coordinates. The portions of the USNG grid coordinate that is imbedded in the UTM coordinate value are underlined for illustrative purposes.

Table 1. Truncation of USNG values Examples of truncated grid coordinates

	Complete grid reference	Truncated coordinates			
		Four digit (1 km)	Six digit (100-m)	Eight digit (10-meter)	Ten digit (1-meter)
UTM	+18,323483.168,4306479.498	2306	234064	23480647	2348306479
USNG	18SUJ2348306479	2306	234064	23480647	2348306479

[2] A similar system of coordinate truncation can be employed for UTM grid coordinates. However, such a system is not part of the UTM standard and is included here in Table 1 for illustration and uniformity purposes.

United States National Grid

Annex D (Informative)

USNG Implementations

ANNEX D (Informative)

USNG Implementations

D.1 Applications

D.1.1 General features

All elements of a grid reference need not be used. Their use depends upon the size of the area of activities, the type of use, and the scale of map to which the reference is keyed. Users will decide which elements of the grid references are to be used based on specific circumstances. The following paragraphs provide guidance for the use of GZDs and 100,000-meter Square Identifications.

D.1.2 Large geographic areas

For situations or issues spanning large geographical areas, such as conterminous United States or Alaska, the GZD is usually given (such as 18S in 18SUJ23480647). The designation will alleviate ambiguity between identical references that may occur when reporting to a station outside the area. The GZD is always used in giving references on 1:1,000,000-scale to 1:500,000 scale maps.

D.1.3 Regional areas

For areas of lesser extent than conterminous United States, but exceeding 100,000 meters, the 100,000-meter Square Identification is used (such as UJ in UJ23480647).

D.1.4 Local areas

For small and localized areas, the GZDs and 100,000-meter Square Identifications need not to be used, unless reporting falls within the parameters explained in preceding paragraphs. In the instance of local reporting, only the numerical part of the grid reference is required (such as 23480647).

D.1.5 For local areas near Grid Zone and/or 100,000-meter Square boundaries

D.1.5.1 Grid Zone Boundary

In this case, GZD and 100,000-meter Square Identification have to be used with the USNG coordinate.

D.1.5.2 100,000-meter Square Boundary

In this case, the 100,000-meter Square Identification has to be used with the USNG coordinate.

D.1.6 Complete grid reference

Topographic maps at 1:500,000 and larger-scales should provide a grid reference box with the elements for making a complete grid reference. See Annex E, Figure 4. Annex E, Figure 5 provides an example of an option for a grid reference box with instructions for making a complete grid reference.

D.1.7 Reading grid coordinates

D.1.7.1 Principal digits

The 10,000-meter and 1,000-meter digits are known as the principal digits and identify grid lines. Preceding UTM values are shown as superscript. Alternatively, only the principal digits for grid lines need be shown, but a sample full UTM value for both the Easting and Northing axis must be depicted at least once on the map. See Annex E, Figures 6 and 7.

D.1.7.2 Read right and up

The numerical part of a grid reference always contains an even number of digits. The first half of the total number of digits represents the Easting, and the second half the Northing. The standard convention of reading "right (Easting) and up (Northing)" is employed.

D.1.7.3 Read right

To read the Easting coordinate, locate the first Easting (vertical grid line to the left of the point of reference and read the large digits, the principal digits labeling the line either in the top or bottom margin or on the line itself. Smaller digits shown as part of a grid number are ignored. Estimate, or scale the distance between the Easting line to the left of the point and the point itself.

D.1.7.4 Read up

The reading of the Northing coordinate is made in a similar manner. Locate the first Northing (horizontal) grid line below the point of reference and read the principal digits labeling the line located in the left or right margin or on the line itself. Then estimate, or scale the distance between the Northing grid line below the point and the point itself.

D.1.7.5 Grid coordinates

The numerical part of a point reference taken from a 1,000-meter grid (on maps at scales of 1:100,000 and larger) is typically either a six-digit or eight-digit number; for example 234064 or 23480647. For a six-digit grid coordinate (i.e. 234064), reading from left to right, the 23 represents the 10,000 and 1,000 digits of the first Easting grid line to the left of the point, the 4 represents the estimated or scaled (nearest 100 meters) from the Easting line to the point, the 06 represents the 10,000 and 1,000 digits of the first Northing grid line below the point, and the 4 represents the estimated or scaled (nearest 100 meters) from the Northing grid line to the point.

D.1.7.6 Example reading of grid coordinates

Refer to Annex E, Figure 8 for the following example.

A reference is written as an entity without spaces, parentheses, dashes, or decimal points. In this example the grid coordinates are shown for a map feature, a small cemetery. From the legend the feature is located in GZD (18S) and 100,000-meter square (TH). For the grid coordinates, read right to the grid intersection immediately left and below the place of interest. In Figure 8, it is line 95. Then count grid lines up to the intersection (in this example 92). The coordinate value 9592 gives the location to within 1,000 meters. Measuring or estimating right in meters from line 95, finds the cemetery is another 410-meters. The complete USNG Easting component is 95410. Measuring up (north) from line 92, the cemetery is another 630 meters. The complete USNG Northing component is 92630. In this example a precision of 10 meters is required, thus the eight digit coordinate value of the cemetery is 95419263. Notice how the 1-meter values of 0 have been dropped in the eight digit grid coordinates. The USNG coordinate values are:

Full USNG:	18STH95419263
Without GZD:	TH95419263
Without GZD and 100,000-meter Square Identification:	95419263

Using the example of the cemetery above, grid coordinates are illustrated below for four, six, eight, and ten digits. These values represent a point position (the southwest corner) for an area of refinement.

Four digits	9592	Locating a point within a 1,000 meter square.
Six digits	954926	Locating a point within a 100 meter square.
Eight digits	95419263	Locating a point within a 10 meter square.
Ten digits	9541092630	Locating a point within a 1 meter square.

United States National Grid

Annex E (Informative)

Informative Figures

United States National Grid

Annex F (Informative)

General Conventions for the USNG

ANNEX F (Informative)

General Conventions for the USNG.

F.1 Appropriate use of truncated values

Full USNG values should be provided when they are used to indicate a spatial address on stationary letterhead, business cards, etc., even though the reader will know from the street address that it is in the vicinity of a given town. This will facilitate someone using USNG spatial addresses with a GPS receiver or digital map. For example:

Department of Interior
1849 C Street NW, Washington, DC 20006
USNG: 18SUJ22850705 (NAD 83)

Alternatively, when two people are exchanging positioning information by voice or other informal means, they will often use only the USNG grid coordinate, such as: "We're located in Washington at 1849 C Street, NW, grid 22850705."

F.2 Geographic indexing

F.2.1 National Atlas or Map

Features should be referenced in a map or atlas index using USNG values. In the case of an atlas, the particular page numbers would also be indicated. For example, the cities of Huntsville can be referenced as:

Huntsville, AL ED 3743

Huntsville, AR	VV 3393
Huntsville, MO	WD 3965
Huntsville, OH	KE 6280
Huntsville, TN	GF 2532
Huntsville, TX	TQ 5501
Huntsville, UT	VL 3567

The exception to this format is Alaska, which exceeds 18° of latitude and longitude in extent (more than three grid zones). For Alaska, the GZD should also be shown.

F.2.2 State map index

An index for a state atlas or map for Texas can reference the city of Huntsville as:

Huntington	UQ 4961
Huntoon	LF 5335
Hunstville	TQ 5501
Huntsville St Park	TP 5790
Hurlwood	GT 7419

In the case of a state atlas, the page numbers for each feature would also be indicated. The exception to this format is again Alaska, where the GZD should also be shown.

F.2.3 City street index

A large-scale atlas or street map for Huntsville, TX can index street names as:

Baker	TP 562995
Beto	TP 571981
Bowers	TQ 570005
Brook	TP 567984
Bush	TQ 543021

Note that since the extent of Huntsville, TX is not larger than 100 x 100 kilometers, the 100,000-meter Square Identifications are not essential in this street index. A city street atlas would also reference the page number unique to that atlas for the street.

F.3 Portrayal of USNG grids and grid values on maps

F.3.1 Grid spacing

On large-scale paper maps, precise measurement requires a fine line square grid. Grids provide the user with a geodetic reference in close proximity to any point on the map facilitating measurement and compensating for paper distortion. The size of grid squares is a trade off between a precise reference tool and clutter. Table 2 provides a proven and useful convention and guide for grid spacing on maps wherein grid squares on maps are no smaller than 20mm nor larger than 100mm along each side.

Table 2. Grid spacing recommendation

Map scale	Grid spacing (On ground in meters.)	Grid spacing (On map in millimeters.)
1:10,000	1,000	100
1:20,000	1,000	50.0
1:24,000	1,000	41.6
1:25,000	1,000	40.0
1:50,000	1,000 or 5,000	20 or 100.0
1:62,500	5,000	80.0
1:63,360	5,000	78.7
1:100,000	10,000	100.0
1:250,000	10,000	40.0
1:500,000	50,000	100.0
1:1,000,000	100,000	100.0

F.3.2 Grid value portrayal

The USNG is based on the UTM grid, and as such the first two digits in USNG Easting and Northing are the same as the 10,000-meter and 1,000-meter digits of UTM Easting and Northing coordinates. Provisions should be made so map users can have essential information for using

USNG coordinate equivalent to UTM coordinate. A sample of at least one full UTM value should be shown for both an Easting and Northing values, preferably in the lower left corner of the map. When UTM values are shown, the principal digits are provided in larger type. Other grid lines should be identified using UTM principal digits (both the 10,000-meter and 1,000-meter UTM values) with the proceeding digits as superscript. Alternatively, only the principal digits for grid lines need be shown, but a sample full UTM value for both the Easting and Northing axis must be depicted at least once on the map. Annex E, Figure 7 depicts how grid lines are labeled and 100,000-meter squares identified on the map and along the neatline.

F.3.3 Grid reference box

Maps at scales 1:500,000 and larger should provide a grid reference box similar in content to either Figure 4 or 5 (Annex E).

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Annex G (Informative)

Why the United States National Grid is Needed

ANNEX G (Informative)

Why the United States National Grid is Needed

Americans have many sources of geographic information to support their day-to-day activities. Commercial street and highway maps are a major source of this information. These commercial products typically carry a system of proprietary atlas grids, unique to a particular map or map brand. Atlas grid coordinates consist of an arbitrary alphanumeric code that locates places within a cell of a given spatial extent.

A community often has a variety of large-scale maps available that use disparate coordinate systems. In a sample of the Washington, DC area conducted in 1998, four years after the Global Positioning System (GPS) reached full operational capability, 25 different large-scale commercial street maps were obtained from retail outlets. On these maps, there existed 21 different coordinate systems. Of these grids, none worked with readily available, low-cost consumer GPS receivers. Some commercial mapmakers claim their maps (and atlas grids) are the de facto standard in some communities, because in some cases, local governments have adopted one of these proprietary atlas grids for use as a spatial address system.

Often organizations with a local focus do not recognize problems inherent in the use of disparate grid systems or the need for a preferred system that is national in scope. Consumers and businesses that must routinely cross interstate and local government boundaries require a solution national in scope. In an emergency scenario where time is precious and understanding communicated locations or positions in a non-conflicting manner is critical, it is operationally best for all to use a standard reference system. When a local government accepts the use of a proprietary coordinate system as a ``de facto" standard, it grants a monopolistic license to a specific commercial map vendor, thereby inhibiting competition in that community's marketplace. The USNG provides commercial map vendors who choose to adopt it a preferred coordinate system that enhances their products by enabling the exchange of spatial address information.

Addressing Schemes

Americans have traditionally used postal or street addresses to locate a destination in their day-to-day activities. In 30 of the 50 States, the Public Land Survey System (PLSS) is another system often used to describe a piece of property. Traditional street addressing schemes have provided a one-dimensional solution, and these will continue to be used. Nonetheless, these systems are flawed by their lack of mathematical uniformity. Additionally, they often lack the ability to provide an address for any point in the nation. These different systems do not work with GPS, or are unreliable for work with GPS and digital maps, and they do not accommodate the level of precision that GPS can provide. With the advent of GPS, the average citizen can purchase access to a $10 billion source of precise positioning information for the price of a good watch. In the near future, vehicles will routinely come equipped with GPS driven digital maps. Mobile wireless communications have become pervasive, allowing community members to cheaply communicate with one another from any point on he globe. When people communicate, one of the fundamental pieces of information they often need to exchange is location. In view of these technological advances, there exists a need to support the community in its use and communications of geospatial information with a preferred spatial address system.

Computer Translation Versus a Preferred System

Some have suggested that because high-speed digital computers can usually translate between different coordinate systems, there is no need for a preferred system for spatial addressing. They contend that computer systems will simply translate a coordinate value from any one of an infinite number of coordinate systems that could be used by the community into one the operator can understand or use. In the real world, this is a flawed concept. First, it will be some time before every citizen has a lap/palm top computer to use for routine navigation. Secondly, it will not be possible to keep every citizen's computer updated with the infinite number of coordinate systems that can be produced. It is analogous to cartographic anarchy, where there are no recognized conventions. Some say the day of the paper map is over, but we have not achieved the ``paperless environment." Paper will continue to be a critical medium for portraying and using geospatial information. While digital information systems such as GPS, the Internet, and print on demand paper maps will increase the ability of the community to use geospatial data, paper maps will continue in widespread use. Maps require a common earth referenced coordinate system if people are to exchange useful positioning information. A preferred spatial addressing convention is required just as a preferred set of street names is used for street addresses. For example, street addresses simply would not be useable if there were multiple names for each street. Accordingly, a preferred convention was necessary if the community was to have a useable and workable spatial address system.

Truncation and Variable Precision

The UTM system most closely meets the USNG requirements and is:

- A plane coordinate system, which is far easier to use than latitude and longitude for large-scale work
- A geodetically referenced, mathematically uniform system in the public domain
- National and international in scope

However, UTM does not provide a convention for truncating coordinate values, nor does it allow for variations in precision of information. For example, although the USNG will support 1-meter precision, many users do not need spatial resolutions finer than 10 meters for location and navigation and do not require that coordinates be shown to all the decimal places to which they are stored in computers. In fact, users find it easier to remember fewer digits. This is analogous to memorizing and recalling telephone numbers.

The MGRS was selected as a model reference scheme because it is a mature, widely used, off-the-shelf system based on the UTM that also provides a method to truncate coordinates and offers various levels of precision. It is widely used on low cost GPS receivers. During its fifty years of use prior to the introduction of the USNG it was taught to, and used by, millions of young men and women of various education levels. It has often been used under highly stressful situations. This body of experience demonstrated it is easily usable by the general population in both routine and highly dynamic situations.

APPLICTION AREAS THAT POTENTIALLY WILL BENEFIT FROM THE USNG

Enhanced 9-1-1. The USNG spatial address will complement the caller's street address on the screen of Enhanced 9-1-1 system operators in Public Safety Access Points (PSAP). Officers on the street, who may be equipped with either paper or digital maps that are properly gridded, can use the USNG spatial address.

Disaster Relief Operations

In the aftermath of natural or man made disasters, the devastation may be so great that street signs are destroyed. Agencies not familiar with such areas find it exceedingly difficult to navigate to places in need of assistance. USNG provides a nationally uniform method for describing a position that allows outside assistance providers to ``hit the ground running'' with GPS equipment and to use commercial street maps that may be readily available and portray the USNG grid.

Search and Rescue (SAR)

The advent of technologies such as medical evacuation helicopters and wireless communications (i.e. radios, Family Radio Service, cellular telephones, etc.) has increased the need to precisely and unambiguously identify places away from the road network. For example, medical evacuation helicopter crews have cited difficulties (while often flying in dangerous environments, i.e. mountainous terrain at night) in understanding SAR team descriptions of where they are supposed to fly. A preferred spatial address system eliminates this communication interoperability problem.

Use With Digital and Paper Maps

Digital maps from sources such as CD ROMs for use on desk/lap top computers and internet information vendors have come into widespread use. The USNG has accuracy that ensures confidence that the point indicated is the correct location. Today, it is possible to quickly access a source of maps on the internet. With a USNG spatial address, the user precisely designates the point of interest by entering the spatial address as if it were a phone number (This has important implications for future cellular phone operations and GPS/car navigation systems). The information provider can quickly respond with a map of that location. The USNG also provides a coordinate system that can be portrayed on these maps when they are printed ("print on demand"), thereby ensuring a geodetic reference for later use of the map with GPS.

Locating Small Business Features

Quite often, it is necessary to locate a small feature such as an Automated Teller Machine (ATM), the drop off box for a package delivery services, or post office boxes. Today, automated sources of information provided by the internet or by telephone indicate the location of the closest ATM or drop-off box, but actually finding these small features can prove to be a difficult task. USNG spatial addressing will greatly ease a customer's task by unambiguously communicating a point position of higher precision than possible with conventional street addresses and will maximize current and future capabilities of GPS.

Locating a Street Address Number

Locating a street address number of buildings or homes can be a difficult task. This is especially true at night or during heavy traffic. Street address numbers may be small, poorly placed, or missing altogether. A virtual address defined by USNG enables the use of GPS or a map with a USNG grid.

Identifying Multiple Businesses Locations

A business with multiple locations in a community can add the spatial address for its establishments in telephone or Internet directories (or other sources of information). This information, coupled with commercial street maps that portray the USNG grid, will allow potential customers to quickly determine which establishment is closest. Customers will easily see the relative location of each store.

Outdoors Recreation

A great deal of outdoors recreation, such as backpacking, kayaking, hunting, fishing, rock climbing, cross-country skiing, snowmobiling, mountain-biking, and horseback riding, takes place away from the road network and the conventional street address system. The widespread availability of low cost wireless communications (i.e. cellular telephones, Family Radio Service transceivers, etc.) has increased the need for a spatial address system that people can use to identify their location in a simple, uniform manner without ambiguity. For example, in the event of an accident requiring medical assistance, USNG provides a standard method for describing the unambiguous location of the accident to responding organizations. Likewise, backpackers and others can report their USNG spatial address for a pickup point after a long hike, adding flexibility to their plans. The USNG provides a universal means for identifying the location of shelters, cabins, trail heads, springs, camping areas, parking areas, and other features in journal entries, magazine articles, guidebooks, internet web sites and other sources of recreational information.

Agriculture

There is a need in agriculture to uniformly identify particular parcels of land for various work tasks. For example, a farmer communicating with a mechanic by cellular phone may need to clearly identify in which field a tractor has broken down. Another example is where the farmer has to instruct a deliverer of some commodity where to stage the material.

Tourism

A uniform spatial address system will enable tourists to quickly and unambiguously locate a place of interest. USNG locations will be noted in brochures and in other sources of tourism information.

United States National Grid

Annex H (Informative)

Glossary

ANNEX H (Informative)

Glossary

ANSI	American National Standards Institute
ATM	Automated Teller Machine
E9-1-1	Enhanced 9-1-1
FGDC	Federal Geographic Data Committee
GIS	Geographic Information System
GPS	Global Positioning System
GZD	Grid Zone Designation
DMA	Defense Mapping Agency
ISO	International Organization for Standardization
ITRF	International Terrestrial Reference Frame
km	kilometer
MGRS	Military Grid Reference System
mm	millimeter
NAD 27	North American Datum 1927
NAD 83	North American Datum 1983
NIMA	National Imagery and Mapping Agency
PLSS	Public Land Survey System
PSAP	Public Safety Access Point
SAR	Search and Rescue
SPCS	State Plane Coordinate System
USNG	United States National Grid
UTM	Universal Transverse Mercator
WGS 84	World Geodetic System 1984